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(19)

(54) METER SYSTEM FOR MEASURING THE DENSITY OF MATERIAL CONVEYED IN PIPELINES

(71) We, AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA KRAKOW, Aleja Mickiewicza 30, Poland, a State Enterprise organised and existing under the laws of Poland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to meter systems for the measurement of the density of material conveyed in pipelines.

According to the present invention there is provided a meter system for measuring the density of material conveyed in a pipeline, said system comprising a capacitive sensor located in the pipeline and electrically connected to form part of an oscillator circuit, a frequency measuring circuit connected to the output of the oscillator circuit, an indicator system connected to the output of the measuring circuit, and a voltage-amplitude-sensitive circuit having an input connected to the output of the oscillator circuit and having an output coupled to compensate the oscillator circuit for variations in conductance of the material in the pipeline.

A feature of the meter system according to the present invention is the fact that the measurements of density of a mixture conveyed in a pipline are highly accurate and that the inertia is kept to a minimum.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings in which:—

Fig. 1 is a comprehensive block diagram of an embodiment of the meter system according to the present invention; and

Fig. 2 is a block diagram of the detailed construction of the system in Fig. 1.

In the drawings, the meter system comprises a capacitive sensor 1 installed in a pipeline 6, a measuring circuit 2, a temperature sensor 4 in the pipeline 6, a compensating system 3 connected to the output of circuit 2 and sensor 4 and an indicator-recording system 5. The circuit 2 includes an oscillator circuit 2*a* to which the capacitive sensor 1 is coupled so that the circuit 2*a* outputs a signal of frequency F*p* which is dependent upon the nature of the material in the pipeline 6, a circuit 2*b* for compensating for errors introduced due to conductance of the material in the pipeline, and a reference generator 2*c* for generating a reference frequency F*o*. The circuit 2 further includes circuits 2*d* to 2*l* connected in cascade for frequency measurement purposes. Circuit 2*d* is a mixer, 2*e* a low-pass filter, 2*f* an amplifier, 2*g* a limiter, 2*h* a differentiator, 2*i* a unipolarity diode, 2*k* a pulse generator for generating standard pulses, and 2*l* an integrator.

The operation of the meter system is as follows. The capacitance variations in the sensor 1, and caused only by variations in density of the material being conveyed in the pipe cause corresponding variations in the frequency only of the oscillator 2*a*. Variation in the conductance of the material in the pipeline 6 however causes corresponding variations in the amplitude of the output from the oscillator 2*a*. These amplitude variations are detected by the circuit 2*b* which has an output coupled to compensate the oscillator. The electric signals from oscillator 2*a* and from the reference generator 2*c* are applied to the input of the frequency mixer 2*d*, a measurement frequency F*p*, a reference frequency F*o*, and frequencies F*p*—F*o* being then obtained at the output of the said mixer. Only the difference frequency F*p*—F*o* is obtained at the output of the low-pass filter 2*e*, said difference frequency being amplified in the amplifier 2*f*. After a suitable treatment in the amplitude limiter 2*f*. After a suitable treatment in the amplitude limiter 2*g*, the differentiating system 2*h*, and in the negative pulse chopper 2*i*, this frequency triggers the standard pulse generator 2*k* so that pulses of suitable repetition rate are obtained at the output of the standard pulse generator 2*k*. The integrating system 2*l* counts these pulses and produces a signal which is proportional to the repetition rate. After a correction in the compensating system 3 which compensates the temperature induced variations in capacity, this signal is applied to the indicator-recording system 5,

said system being calibrated e.g. in the units of density, thereby displaying a reading of density of the material flowing through the pipe.

WHAT WE CLAIM IS:—

1. A meter system for measuring the density of material conveyed in a pipeline, said system comprising a capacitive sensor located in the pipeline and electrically connected to form part of an oscillator circuit, a frequency measuring circuit connected to the output of the oscillator circuit, an indicator system connected to the output of the measuring circuit, and a voltage-amplitude-sensitive circuit having an input connected to the output of the oscillator circuit and having an output coupled to compensate the oscillator circuit for variations in conductance of the material in the pipeline.

2. A meter system for measuring the density of material conveyed in pipelines, substantially as hereinbefore described with reference to the accompanying drawings.

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Sheet 1

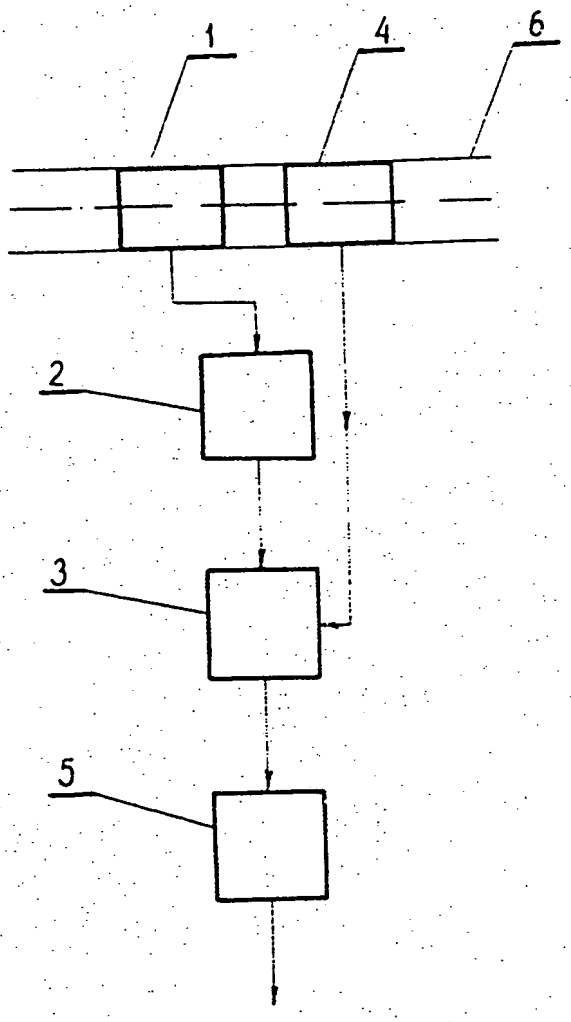

Fig 1

1475593 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

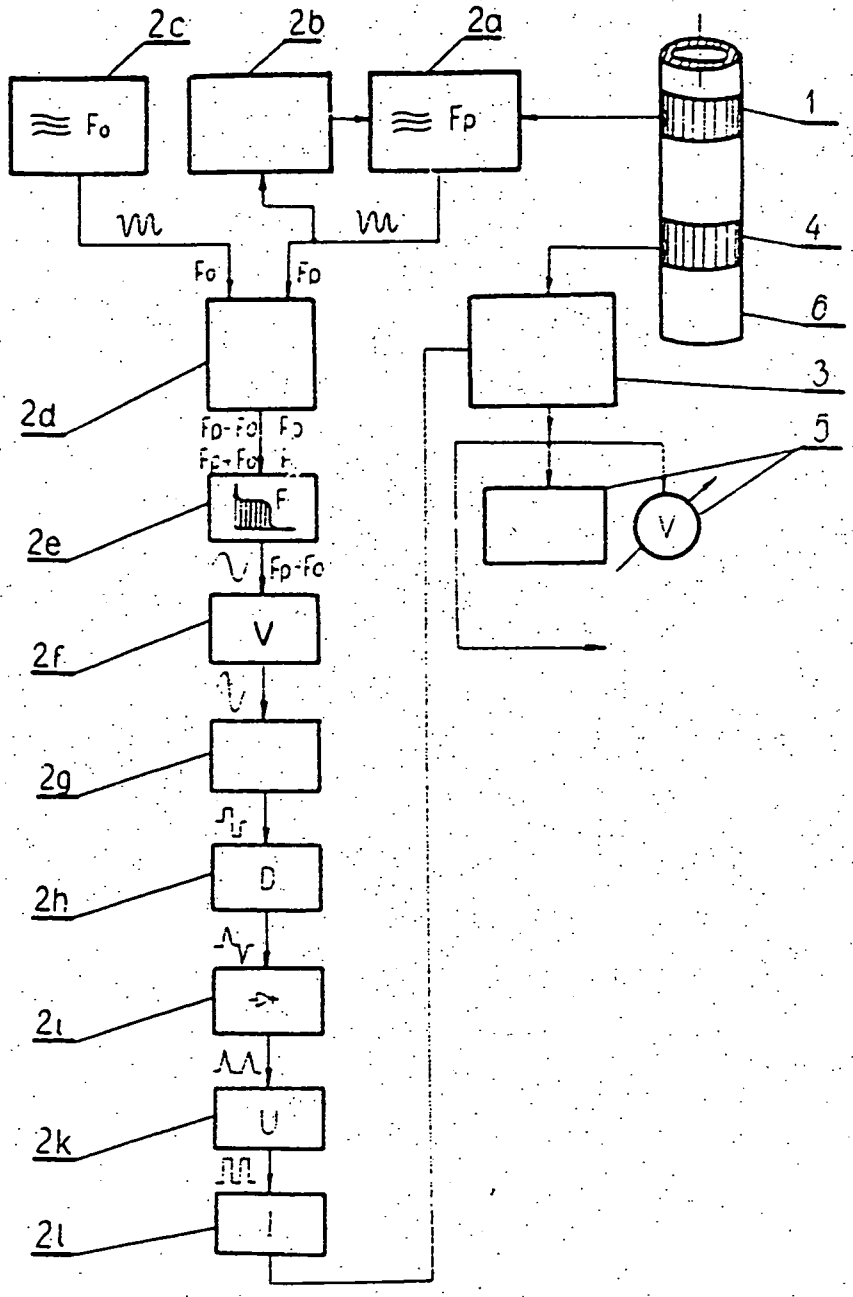

Fig 2